TOPIC: 192003
KNOWLEDGE: K1.01   [2.7/2.8]
QID: P347   (B350)

Which one of the following statements is a characteristic of subcritical multiplication?

A. The subcritical neutron level is directly proportional to the neutron source strength.

B. Doubling the indicated count rate by reactivity additions will reduce the margin to criticality by approximately one quarter.

C. For equal reactivity additions, it takes less time for the new equilibrium source range count rate to be reached as K_{eff} approaches unity.

D. An incremental withdrawal of a given control rod will produce an equivalent equilibrium count rate increase, whether K_{eff} is 0.88 or 0.92.

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.01   [2.7/2.8]
QID: P448   (B1949)

A subcritical reactor has an initial source/startup range count rate of 150 cps with a shutdown reactivity of -2.0% $\Delta K/K$. How much positive reactivity must be added to establish a stable count rate of 300 cps?

A. 0.5% $\Delta K/K$

B. 1.0% $\Delta K/K$

C. 1.5% $\Delta K/K$

D. 2.0% $\Delta K/K$

ANSWER: B.

TOPIC: 192003
KNOWLEDGE: K1.01   [2.7/2.8]
QID: P848   (B2149)

A subcritical reactor has an initial K_{eff} of 0.8 at a source range count rate of 100 cps. Positive reactivity is added until K_{eff} equals 0.95. What is the final equilibrium source range count rate?

A. 150 cps

B. 200 cps

C. 300 cps

D. 400 cps

ANSWER: D.

TOPIC: 192003
KNOWLEDGE: K1.01   [2.7/2.8]
QID: P1348   (B1449)

A reactor is shutdown by 1.8% $\Delta K/K$. Positive reactivity is added which increases stable neutron count rate from 15 to 300 cps.

Assuming the reactor is still subcritical, what is the current value of K_{eff}?

A. 0.982

B. 0.990

C. 0.995

D. 0.999

ANSWER: D.

TOPIC: 192003
KNOWLEDGE: K1.01   [2.7/2.8]
QID: P1448   (B1840)

A subcritical reactor has an initial source/startup range count rate of 150 cps with a shutdown reactivity of -2.0% ΔK/K. Approximately how much positive reactivity must be added to establish a stable count rate of 600 cps?

A. 0.5% ΔK/K

B. 1.0% ΔK/K

C. 1.5% ΔK/K

D. 2.0% ΔK/K

ANSWER: C.

TOPIC: 192003
KNOWLEDGE: K1.01   [2.7/2.8]
QID: P1748

A subcritical reactor has an initial source/startup range count rate of 60 cps with a shutdown reactivity of -2.0% ΔK/K. How much positive reactivity must be added to establish a stable count rate of 300 cps?

A. 0.4% ΔK/K

B. 0.6% ΔK/K

C. 1.4% ΔK/K

D. 1.6% ΔK/K

ANSWER: D.

TOPIC: 192003
KNOWLEDGE: K1.01   [2.7/2.8]
QID: P1848   (B1170)

A nuclear power plant that has been operating at rated power for two months experiences a reactor trip. Two months after the reactor trip, with all control rods still fully inserted, a stable count rate of 20 cps is indicated on the source/startup range nuclear instruments.

The majority of the source/startup range detector output is being caused by the interaction of _____ with the detector.

A. intrinsic source neutrons

B. fission gammas from previous power operation

C. fission neutrons from subcritical multiplication

D. delayed fission neutrons from previous power operation

ANSWER: C.

TOPIC: 192003
KNOWLEDGE: K1.01   [2.7/2.8]
QID: P2248   (B2249)

Two reactors are currently shut down with a reactor startup in progress. The two reactors are identical except that reactor A has a source neutron strength of 100 neutrons per second and reactor B source neutron strength is 200 neutrons per second. Control rods are stationary and Keff is 0.98 in both reactors.   Core neutron level has reached equilibrium in both reactors.

Which one of the following lists the core neutron level (neutrons per second) in reactors A and B?

Reactor A	Reactor B
A. 5,000	10,000
B. 10,000	20,000
C. 10,000	40,000
D. 20,000	40,000

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.01   [2.7/2.8]
QID: P2448   (B2649)

A reactor startup is being performed with xenon-free conditions. Control rod withdrawal is stopped when K_{eff} equals 0.995 and count rate satbilizes at 1,000 cps. No additional operator actions are taken.

Which one of the following describes the count rate 20 minutes after rod withdrawal is stopped?

A. 1,000 cps and constant.

B. Less than 1,000 cps and decreasing toward the prestartup count rate.

C. Less than 1,000 cps and stable above the prestartup count rate.

D. Greater than 1,000 cps and increasing toward criticality.

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.01   [2.7/2.8]
QID: P3048   (B3049)

A reactor startup is being commenced with initial source (startup) range count rate stable at 20 cps. After a period of control rod withdrawal, count rate stabilizes at 80 cps.

If the total reactivity added by the above control rod withdrawal is 4.5 %ΔK/K, how much additional positive reactivity must be inserted to make the reactor critical?

A. 1.5 %ΔK/K

B. 2.0 %ΔK/K

C. 2.5 %ΔK/K

D. 3.0 %ΔK/K

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.01   [2.7/2.8]
QID: P3348

A xenon-free shutdown reactor plant is slowly cooling down due to an unisolable steam leak. When the cooldown started at 400°F, the readings on all source range nuclear instruments were 80 counts per second (cps). After one hour, when the reactor coolant temperature reached 350°F, source range count rate was 160 cps on all source range instruments.

Assume that the moderator temperature coefficient remains constant throughout the cooldown, and <u>no</u> operator action is taken. What will be the status of the reactor when reactor coolant temperature reaches 290°F?

A. Subcritical, with source range count rate below 320 cps

B. Subcritical, with source range count rate above 320 cps

C. Supercritical, with source range count rate below 320 cps

D. Supercritical, with source range count rate above 320 cps

ANSWER: D.

TOPIC: 192003
KNOWLEDGE: K1.01   [2.7/2.8]
QID: P3848   (B3849)

A reactor is shutdown with a K_{eff} of 0.8. The source range count rate is stable at 800 cps. What percentage of the core neutron population is being contributed directly by neutron sources other than neutron-induced fission?

A. 10%

B. 20%

C. 80%

D. 100%

ANSWER: B.

TOPIC: 192003
KNOWLEDGE: K1.01   [2.7/2.8]
QID: P3925   (B3925)

A reactor startup is in progress at a nuclear power plant with core K_{eff} equal to 0.90. By what factor will the core neutron level have increased when the reactor is stabilized with core K_{eff} equal to 0.99?

A. 10

B. 100

C. 1,000

D. 10,000

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.05   [2.7/2.8]
QID: P548

Reactor power was increased from 10^{-9}% to 10^{-6}% in 6 minutes. The average startup rate was _____ decades per minute.

A. 0.5

B. 1.3

C. 2.0

D. 5.2

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.05   [2.7/2.8]
QID: P648

Reactor power increases from 10^{-8}% to 5×10^{-7}% in 2 minutes. What is the average startup rate?

A. 0.95 dpm

B. 0.90 dpm

C. 0.85 dpm

D. 0.82 dpm

ANSWER: C.

TOPIC: 192003
KNOWLEDGE: K1.05   [2.7/2.8]
QID: P2349   (B2351)

During a reactor startup, reactor power increases from 1E-8% to 2E-8% in 2 minutes with no operator action. Which one of the following is the average reactor period during the power increase?

A. 173 seconds

B. 235 seconds

C. 300 seconds

D. 399 seconds

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.05   [2.7/2.8]
QID: P2648   (B1651)

During a reactor startup, reactor power increases from 3×10^{-6}% to 5×10^{-6}% in 2 minutes with no operator action. Which one of the following was the average reactor period during the power increase?

A. 357 seconds

B. 235 seconds

C. 155 seconds

D. 61 seconds

ANSWER: B.

TOPIC: 192003
KNOWLEDGE: K1.06   [3.2/3.3]
QID: P47   (B451)

A given amount of positive reactivity is added to a critical reactor in the source (startup) range. The amount added is less than the average effective delayed neutron fraction. Which one of the following will have a significant effect on the magnitude of the stable startup rate achieved for this addition?

A. Prompt neutron lifetime

B. Fuel temperature coefficient

C. Average effective decay constant

D. Moderator temperature coefficient

ANSWER: C.

TOPIC: 192003
KNOWLEDGE: K1.06   [3.2/3.3]
QID: P126

The plant is operating steady-state at 50% power at middle of core life. Which one of the following conditions will initially produce a positive startup rate?

A. Increase in turbine loading

B. Unintentional boration

C. Turbine runback

D. Closure of a letdown isolation valve

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.06   [3.2/3.3]
QID: P248

The magnitude of the stable startup rate achieved for a given positive reactivity addition to a critical reactor is dependent on the _____ and _____.

A. prompt neutron lifetime; axial flux distribution

B. prompt neutron lifetime; average delayed neutron fraction

C. average effective decay constant; average delayed neutron fraction

D. average effective decay constant; axial flux distribution

ANSWER: C.

TOPIC: 192003
KNOWLEDGE: K1.06   [3.2/3.3]
QID: P2748   (B2751)

A reactor is exactly critical at 10^{-8}% power during a reactor startup. $\bar{\beta}$ for this reactor is 0.0072. Which one of the following is the approximate amount of positive reactivity that must be added to the core by control rod withdrawal to initiate a reactor power increase toward the point of adding heat with a stable startup rate of 1 dpm?

A. 0.2% ΔK/K

B. 0.5% ΔK/K

C. 1.0% ΔK/K

D. 2.0% ΔK/K

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.06   [3.2/3.3]
QID: P3148   (B3151)

A reactor is being started for the first time following a refueling outage. Reactor Engineering has determined that during the upcoming fuel cycle $\overline{\beta}_{eff}$ will range from a maximum of 0.007 to a minimum of 0.005.

Once the reactor becomes critical, control rods are withdrawn to insert a net positive reactivity of 0.1% $\Delta K/K$ into the reactor core. Assuming no other reactivity additions, what will be the approximate stable reactor period for this reactor until the point of adding heat is reached?

A. 20 seconds

B. 40 seconds

C. 60 seconds

D. 80 seconds

ANSWER: C.

TOPIC: 192003
KNOWLEDGE: K1.06   [3.2/3.3]
QID: P3548   (B3551)

Reactors A and B are identical except that the reactor cores are at different times in core life. The reactor A effective delayed neutron fraction is 0.007, and the reactor B effective delayed neutron fraction is 0.005. Both reactors are currently subcritical and stable with neutron flux level in the source range.

Given:

    Reactor A K_{eff} = 0.999
    Reactor B K_{eff} = 0.998

If positive 0.003 ∆K/K is suddenly added to each reactor, how will the resulting stable reactor startup rates (SUR) compare? (Consider only the reactor response while power is below the point of adding heat.)

A. Reactor A stable SUR will be higher because it will have the higher positive reactivity in the core.

B. Reactor B stable SUR will be higher because it has the smaller effective delayed neutron fraction.

C. Reactors A and B will have the same stable SUR because both reactors will remain subcritical.

D. Reactors A and B will have the same stable SUR because both reactors received the same amount of positive reactivity.

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.07   [3.0/3.0]
QID: P48   (B1950)

Over core life, plutonium isotopes are produced with delayed neutron fractions that are _____ than uranium delayed neutron fractions, thereby causing reactor power transients to be _____ near the end of core life.

A. larger; slower

B. larger; faster

C. smaller; slower

D. smaller; faster

ANSWER: D.

TOPIC: 192003
KNOWLEDGE: K1.07   [3.0/3.0]
QID: P129

When does the power decrease rate initially stabilize at negative one-third decade per minute following a reactor trip?

A. When decay gamma heating starts adding negative reactivity

B. When the long-lived delayed neutron precursors have decayed away

C. When the installed neutron source contribution to the total neutron flux becomes significant

D. When the short-lived delayed neutron precursors have decayed away

ANSWER: D.

TOPIC: 192003
KNOWLEDGE: K1.07   [3.0/3.0]
QID: P249

Delayed neutrons contribute more to reactor stability than prompt neutrons because they _____ the average neutron generation time and are born at a _____ kinetic energy.

A. increase; lower

B. increase; higher

C. decrease; lower

D. decrease; higher

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.07   [3.0/3.0]
QID: P348   (B2450)

Which one of the following statements describes the <u>effect</u> of changes in the delayed neutron fraction from beginning of core life (BOL) to end of core life (EOL)?

A. A given set of plant parameters at EOL yields a greater shutdown margin (SDM) than at BOL.

B. A given set of plant parameters at EOL yields a smaller SDM than at BOL.

C. A given reactivity addition at EOL results in a higher startup rate (SUR) than it would at BOL.

D. A given reactivity addition at EOL results in a lower SUR than it would at BOL.

ANSWER: C.

TOPIC: 192003
KNOWLEDGE: K1.07   [3.0/3.0]
QID: P1149 (B2651)

Delayed neutrons are important for reactor control because...

A. they are produced with higher average kinetic energy than prompt neutrons.

B. they prevent the moderator temperature coefficient from becoming positive.

C. they are the largest fraction of the neutrons produced from fission.

D. they greatly extend the average neutron generation lifetime.

ANSWER: D.

TOPIC: 192003
KNOWLEDGE: K1.07   [3.0/3.0]
QID: P1248 (B1349)

Two reactors are identical in every way except that reactor A is at end of core life and reactor B is at the beginning of core life. Both reactors are operating at 100% power when a reactor trip occurs at the same time on each reactor.

If the reactor systems for each reactor respond identically to the trip and no operator action is taken, reactor A will attain a negative _____ second stable period and reactor B will attain a negative _____second stable period. (Assume control rod worth equals -0.9700 $\Delta K/K$ and λ_{eff} equals 0.0124 sec^{-1}.)

A. 80; 56

B. 80; 80

C. 56; 56

D. 56; 80

ANSWER: B.

TOPIC: 192003
KNOWLEDGE: K1.07   [3.0/3.0]
QID: P1548   (B1250)

Two reactors are identical in every way except that reactor A is at the end of core life and reactor B is at the beginning of core life. Both reactors are critical at 10^{-5}% power.

If the same amount of positive reactivity is added to each reactor at the same time, the point of adding heat will be reached first by reactor _____ because it has a _____ delayed neutron fraction.

A. A; smaller

B. A; larger

C. B; smaller

D. B; larger

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.07   [3.0/3.0]
QID: P1649   (B1649)

Two reactors are identical in every way except that reactor A is at the end of core life and reactor B is at the beginning of core life. Both reactors are operating at 100% power when a reactor trip occurs at the same time on each reactor.

If the reactor systems for each reactor respond identically to the trip and no operator action is taken, a power level of 10^{-5}% will be reached first by reactor _____ because it has a _____ delayed neutron fraction.

A. A; larger

B. B; larger

C. A; smaller

D. B; smaller

ANSWER: C.

TOPIC: 192003
KNOWLEDGE: K1.07   [3.0/3.0]
QID: P1749   (B1751)

Which one of the following is the reason that delayed neutrons are so effective at controlling the rate of reactor power changes?

A. Delayed neutrons make up a large fraction of the fission neutrons in the core compared to prompt neutrons.

B. Delayed neutrons have a long mean lifetime compared to prompt neutrons.

C. Delayed neutrons produce a large amount of fast fission compared to prompt neutrons.

D. Delayed neutrons are born with high kinetic energy compared to prompt neutrons.

ANSWER: B.

TOPIC: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P2249 (B2250)

Which one of the following distributions of fission percentages in a reactor will result in the largest reactor core effective delayed neutron fraction?

	U-235	U-238	Pu-239
A.	90%	7%	3%
B.	80%	6%	14%
C.	70%	7%	23%
D.	60%	6%	34%

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P2348 (B2349)

Which one of the following percentages of fission, by fuel, ocurring in a reactor will result in the smallest reactor core effective delayed neutron fraction?

	U-235	U-238	Pu-239
A.	90%	7%	3%
B.	80%	6%	14%
C.	70%	7%	23%
D.	60%	6%	34%

ANSWER: D.

TOPIC: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P2849 (B2850)

Two reactors are identical in every way except that reactor A is at the beginning of core life and reactor B is at the end of core life. Both reactors are critical at 10^{-5}% power.

If the same amount of positive reactivity is added to each reactor at the same time, the point of adding heat will be reached first by reactor _____ because it has a _____ delayed neutron fraction.

A. A; smaller

B. A; larger

C. B; smaller

D. B; larger

ANSWER: C.

TOPIC: 192003
KNOWLEDGE: K1.07   [3.0/3.0]
QID: P2948   (B2950)

A typical PWR reactor plant is operating at equilibrium 50% power when a control rod is ejected from the core. Which one of the following combinations of fission percentages, by fuel, would result in the highest reactor startup rate? (Assume the reactivity worth of the ejected control rod is the same for each case.)

	U-235	U-238	Pu-239
A.	60%	6%	34%
B.	70%	7%	23%
C.	80%	6%	14%
D.	90%	7%	3%

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.07   [3.0/3.0]
QID: P3248   (B3249)

Two nuclear reactors are identical in every way except that reactor A is near the end of core life and reactor B is near the beginning of core life. Both reactors are operating at 100% power when a reactor trip occurs at the same time on each reactor. The reactor systems for each reactor respond identically to the trip and no operator action is taken.

Ten minutes after the trip, the higher fission rate will exist in reactor _____ because it has a _____ delayed neutron fraction.

A. A; larger

B. B; larger

C. A; smaller

D. B; smaller

ANSWER: B.

TOPIC: 192003
KNOWLEDGE: K1.07   [3.0/3.0]
QID: P3648   (B3650)

Two reactors are identical in every way except that reactor A is at the beginning of core life and reactor B is near the end of core life. Both reactors are operating at 100% power when a reactor trip occurs at the same time on each reactor. The reactor systems for each reactor respond identically to the trip and no operator action is taken.

Ten minutes after the trip, the higher shutdown fission rate will exist in reactor _____ because it has a _____ delayed neutron fraction.

A. A; larger

B. B; larger

C. A; smaller

D. B; smaller

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.07   [3.0/3.0]
QID: P3748   (B3749)

A step positive reactivity addition of 0.001 $\Delta K/K$ is made to a reactor with a stable neutron population and an initial core K_{eff} of 0.99. Consider the following two cases:

    Case 1: The reactor is near the beginning of core life.
    Case 2: The reactor is near the end of core life.

Assume the initial core neutron population is the same for each case. Which one of the following correctly compares the prompt jump in core neutron population and the final stable core neutron population for the two cases?

A. The prompt jump will be greater for case 1, but the final stable neutron population will be the same for both cases.

B. The prompt jump will be greater for case 2, but the final stable neutron population will be the same for both cases.

C. The prompt jump will be the same for both cases, but the final stable neutron population will be greater for case 1.

D. The prompt jump will be the same for both cases, but the final stable neutron population will be greater for case 2.

ANSWER: B.

TOPIC: 192003
KNOWLEDGE: K1.07   [3.0/3.0]
QID: P3849

A reactor is critical in the source range during the initial reactor startup immediately following a refueling outage. The core average delayed neutron fraction is 0.0062. The operator adds positive reactivity to establish a stable 0.5 dpm startup rate.

If the reactor had been at the end of core life with a core average delayed neutron fraction of 0.005, what would be the approximate stable startup rate after the addition of the same amount of positive reactivity?

A. 0.55 dpm

B. 0.65 dpm

C. 0.75 dpm

D. 0.85 dpm

ANSWER: B.

TOPIC: 192003
KNOWLEDGE: K1.08   [2.8/2.9]
QID: P549   (B3351)

Which one of the following describes a condition in which a reactor is prompt critical?

A. A very long reactor period makes reactor control very sluggish and unresponsive.

B. The fission process is occurring so rapidly that the delayed neutron fraction approaches zero.

C. Any increase in reactor power requires a reactivity addition equal to the fraction of prompt neutrons in the core.

D. The net positive reactivity in the core is greater than or equal to the magnitude of the average effective delayed neutron fraction.

ANSWER: D.

TOPIC: 192003
KNOWLEDGE: K1.08   [2.8/2.9]
QID: P748   (B664)

A critical reactor will become prompt critical when reactivity is added equal in magnitude to the...

A. shutdown margin.

B. average effective delayed neutron fraction.

C. average effective decay constant.

D. worth of the most reactive rod.

ANSWER: B.

TOPIC: 192003
KNOWLEDGE: K1.08   [2.8/2.9]
QID: P949

A reactor is operating at 75% power with the following conditions:

Power defect   = -0.0157 Δ/K/K
Shutdown margin   = 0.0241 Δ/K/K
Effective delayed neutron fraction = 0.0058
Effective prompt neutron fraction   = 0.9942

How much positive reactivity must be added to take the reactor "prompt critical"?

A. 0.0157 ΔK/K

B. 0.0241 ΔK/K

C. 0.0058 ΔK/K

D. 0.9942 ΔK/K

ANSWER: C.

TOPIC: 192003
KNOWLEDGE: K1.08   [2.8/2.9]
QID: P1449   (B1850)

A reactor is exactly critical several decades below the point of adding heat (POAH) with a xenon-free core. The operator continuously withdraws control rods until a positive 60 second reactor period is reached and then stops control rod motion.

When rod withdrawal is stopped, reactor period will immediately: (Neglect reactivity effects of fission products.)

A. stabilize at 60 seconds until power reaches the POAH.

B. lengthen, and then stabilize at a value greater than 60 seconds until power reaches the POAH.

C. stabilize, and then slowly and continuously lengthen until power reaches the POAH.

D. lengthen, and then continue to slowly lengthen until power reaches the POAH.

ANSWER: B.

TOPIC: 192003
KNOWLEDGE: K1.08   [2.8/2.9]
QID: P1948   (B1150)

Positive reactivity is continuously added to a critical reactor. Which one of the following values of core K_{eff} will first result in a prompt critical reactor?

A. 1.0001

B. 1.001

C. 1.01

D. 1.1

ANSWER: C.

TOPIC: 192003
KNOWLEDGE: K1.08   [2.8/2.9]
QID: P2049

A reactor has a positive 1.0 dpm startup rate with no control rod motion several decades below the point of adding heat (POAH) with a xenon-free core. The operator then inserts control rods until a 0.5 dpm startup rate is attained and then stops control rod motion.

When rod insertion is stopped, reactor startup rate will immediately...

A. stabilize at 0.5 dpm until power reaches the POAH.

B. increase, and then stabilize at a value greater than 0.5 dpm until power reaches the POAH.

C. stabilize, and then slowly and continuously decrease until startup rate is zero when power reaches the POAH.

D. increase, and then slowly and continuously decrease until startup rate is zero when power reaches the POAH.

ANSWER: B.

TOPIC: 192003
KNOWLEDGE: K1.08   [2.8/2.9]
QID: P2549

A reactor was stable at 80% power when the reactor operator withdrew control rods continuously for 2 seconds. Which one of the following affects the amount of "prompt jump" increase in reactor power for the control rod withdrawal?

A. The duration of control rod withdrawal

B. The differential control rod worth

C. The total control rod worth

D. The magnitude of the fuel temperature coefficient

ANSWER: B.

TOPIC: 192003
KNOWLEDGE: K1.08   [2.8/2.9]
QID: P2949   (B2951)

A reactor is operating at equilibrium 75% power with the following conditions:

  Total power defect   = -0.0185 $\Delta K/K$
  Shutdown margin   = 0.0227 $\Delta K/K$
  Effective delayed neutron fraction = 0.0061
  Effective prompt neutron fraction   = 0.9939

How much positive reactivity must be added to make the reactor "prompt critical"?

A. 0.0061 $\Delta K/K$

B. 0.0185 $\Delta K/K$

C. 0.0227 $\Delta K/K$

D. 0.9939 $\Delta K/K$

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.08   [2.8/2.9]
QID: P3249 (B3250)

Refer to the unlabeled reactor response curve shown below for a reactor that was initially stable in the source range.   Both axes have linear scales. A small amount of positive reactivity was added at time = 0 sec.

The response curve shows _____ versus time for a reactor that was initially _____.

A. startup rate; subcritical

B. startup rate; critical

C. reactor fission rate; subcritical

D. reactor fission rate; critical

ANSWER: C.
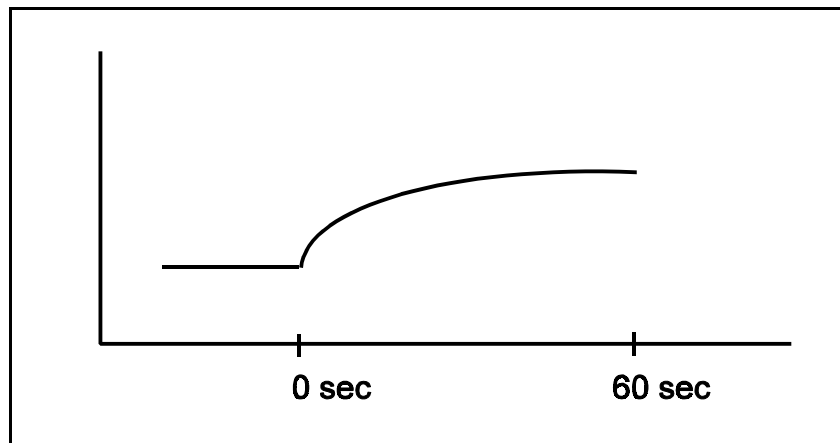
TOPIC: 192003
KNOWLEDGE: K1.08   [2.8/2.9]
QID: P3449   (B3450)

Two reactors, A and B, are exactly critical low in the intermediate range (well below the point of adding heat). The reactors are identical except that reactor A is near the beginning of core life (BOL) and reactor B is near the end of core life (EOL). Assume that a step addition of positive reactivity (0.001 ΔK/K) is added to each reactor. Select the combination below that completes the following statement.

The size of the prompt jump in core power observed for reactor B (EOL) will be _____ than reactor A (BOL); and the stable startup rate observed for reactor B (EOL) will be _____ than reactor A (BOL).

A. larger; larger

B. larger; smaller

C. smaller; larger

D. smaller; smaller

ANSWER: A.
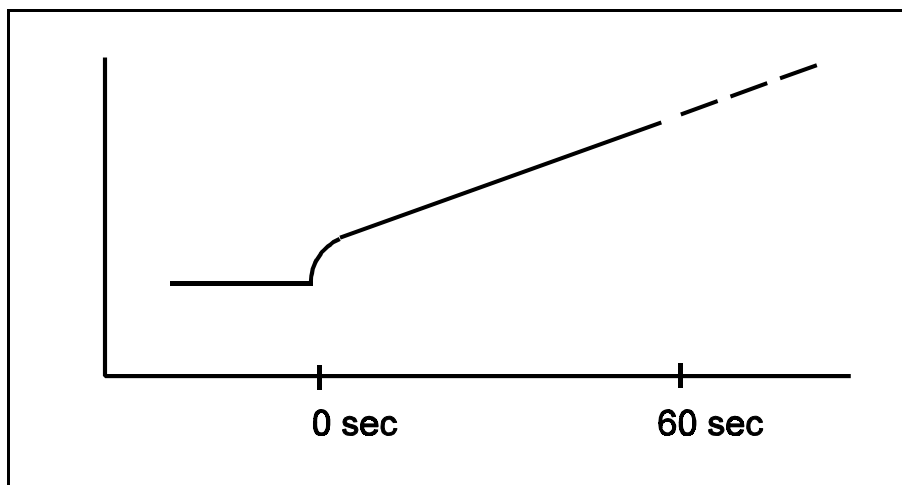
TOPIC: 192003
KNOWLEDGE: K1.08   [2.8/2.9]
QID: P3649   (B3651)

Refer to the unlabeled reactor response curve shown below for a reactor that was initially subcritical in the source range. A small amount of positive reactivity was added at time = 0 sec.

The response curve shows _____ versus time for a reactor that is currently (at time = 60 sec) _____.

A. startup rate; exactly critical

B. startup rate; supercritical

C. reactor fission rate; exactly critical

D. reactor fission rate; supercritical

ANSWER: D.

TOPIC: 192003
KNOWLEDGE: K1.08 [2.8/2.9]
QID: P3749 (B3750)

A reactor is operating at equilibrium 75% power with the following conditions:

Total power defect = -0.0176 ΔK/K
Shutdown margin = 0.0234 ΔK/K
Effective delayed neutron fraction = 0.0067
Effective prompt neutron fraction = 0.9933

How much positive reactivity must be added to make the reactor "prompt critical"?

A. 0.0067 ΔK/K

B. 0.0176 ΔK/K

C. 0.0234 ΔK/K

D. 0.9933 ΔK/K

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.11   [2.7/2.8]
QID: P49

An installed neutron source...

A. maintains the production of neutrons high enough to allow the reactor to achieve criticality.

B. provides a means to allow reactivity changes to occur in a subcritical reactor.

C. generates a sufficient neutron population to start the fission process and initiate subcritical multiplication.

D. provides a neutron level that is detectable on the source range nuclear instrumentation.

ANSWER: D.

TOPIC: 192003
KNOWLEDGE: K1.11   [2.7/2.8]
QID: P349

Neutron sources are installed in the reactor core for which one of the following reasons?

A. To decrease the amount of fuel load required for criticality

B. To compensate for those neutrons absorbed in burnable poisons

C. To augment shutdown neutron population to allow detection on nuclear instrumentation

D. To provide enough neutrons in a shutdown reactor to start a chain reaction for reactor startup

ANSWER: C.

TOPIC: 192003
KNOWLEDGE: K1.11   [2.7/2.8]
QID: P1249

Which one of the following neutron reactions produces the largest contribution to the intrinsic source neutron level immediately following a reactor trip from extended power operations during the tenth fuel cycle? (Neglect any contribution from an installed neutron source.)

A. Alpha-neutron reactions

B. Beta-neutron reactions

C. Photo-neutron reactions

D. Spontaneous fission

ANSWER: C.

TOPIC: 192003
KNOWLEDGE: K1.11   [2.7/2.8]
QID: P1549   (B1549)

Which one of the following intrinsic/natural neutron sources undergoes the most significant source strength reduction during the 1-hour period immediately following a reactor scram from steady-state 100% power?

A. Spontaneous fission reactions

B. Photo-neutron reactions

C. Alpha-neutron reactions

D. Transuranic isotope decay

ANSWER: B.

TOPIC: 192003
KNOWLEDGE: K1.11   [2.7/2.8]
QID: P2149   (B2150)

After the first fuel cycle, subcritical multiplication can produce a visible neutron level indication on the source range nuclear instrumentation for a significant time period following a reactor shutdown from extended power operations, without installed neutron sources. This is because a sufficient number of source neutrons is being produced by intrinsic sources, with the largest contributor during the first few days after shutdown being...

A. spontaneous neutron emission from control rods.

B. photo-neutron reactions in the moderator.

C. spontaneous fission in the fuel.

D. alpha-neutron reactions in the fuel.

ANSWER: B.

TOPIC: 192003
KNOWLEDGE: K1.11   [2.7/2.8]
QID: P3149   (B967)

Which one of the following describes the purpose of a neutron source that is installed in a reactor during refueling for the third fuel cycle?

A. Ensures shutdown neutron level is large enough to be detected by nuclear instrumentation.

B. Provides additional excess reactivity to increase the length of the fuel cycle.

C. Amplifies the electrical noise fluctuations observed in source/startup range instrumentation during shutdown.

D. Supplies the only shutdown source of neutrons available to begin a reactor startup.

ANSWER: A.